

Question 21 (Answer: B)

- Every halide gives the simple acid–base reaction of equation 1.
- Equation 2 needs the halide to *reduce* sulfur from +6 to +4, and chloride is too weak a reducing agent for that.
- Bromide and iodide are both strong enough, so Q is Br^- or I^- .

Question 22 (Answer: A)

- H_2S means sulfur has been reduced all the way from +6 to –2, and only iodide can do that – X is the iodide.
- Y causes no change in sulfur's oxidation number, so Y is the chloride.
- Iodide is a strong enough reducing agent to reduce bromine to bromide, so A is the correct statement.

Question 21 (Answer: B)

- A halogen reacts with a halide only if the halogen is *higher* in the group.
- Chlorine is above bromine, so Cl_2 reacts at once with HBr – that is X with Z.
- Two halogens do not react with each other, and bromide cannot reduce iodine, so both other pairings give nothing.

3(a)(i)	M1 Heat (solid FA 5) AND observe condensation, droplets, steam, water vapour M2 Make an aqueous solution of FA 5 / dissolve in water to use for tests M3 (To portion of the solution) add aqueous NH_3 AND white ppt AND insoluble in excess NH_3 M4 (To portion of the solution) add aqueous barium chloride or barium nitrate AND white precipitate M5 to distinguish sulfate / sulfite (white precipitate from M4) insoluble in hydrochloric OR nitric acid OR KMnO_4 is not decolourised / remains purple (added after M4 or directly to FA 5 (aq))						
3(a)(ii)	<table><tr><td>Zn^{2+}</td><td>X</td></tr><tr><td>SO_4^{2-}</td><td>✓</td></tr><tr><td>H_2O</td><td>✓</td></tr></table>	Zn^{2+}	X	SO_4^{2-}	✓	H_2O	✓
Zn^{2+}	X						
SO_4^{2-}	✓						
H_2O	✓						
3(b)(i)	• (FA 6) starting colour purple • solid jumps / moves around • black residue • test with glowing splint • splint relights / glows more brightly						
3(b)(ii)	(dark) Green						

3(c)(i)	'No change' 2 correct = *, 3 correct = ** 2* = 1 mark Max mark = 4																									
	<table border="1"> <thead> <tr> <th rowspan="2"><i>test</i></th><th colspan="3"><i>observations</i></th></tr> <tr> <th>FA 7</th><th>FA 8</th><th>FA 9</th></tr> </thead> <tbody> <tr> <td>Test 1 Add hydrogen peroxide</td><td>Bubbles/ effervescence * Purple / FA 7 (solution) to colourless (solution) * (Gas / oxygen) relights glowing splint *</td><td>No change</td><td>Bubbles / effervescence * (Gas/ oxygen) relights glowing splint *</td></tr> <tr> <td>Test 2 Add sodium hydroxide, then</td><td></td><td>Off-white ppt*</td><td>No change</td></tr> <tr> <td>leave to stand</td><td></td><td>brown ppt on standing*</td><td></td></tr> <tr> <td>Test 3 Add aqueous iron(II) sulfate</td><td>Turns colourless / yellow OR colourless / yellow solution formed*</td><td>No change</td><td></td></tr> </tbody> </table>			<i>test</i>	<i>observations</i>			FA 7	FA 8	FA 9	Test 1 Add hydrogen peroxide	Bubbles/ effervescence * Purple / FA 7 (solution) to colourless (solution) * (Gas / oxygen) relights glowing splint *	No change	Bubbles / effervescence * (Gas/ oxygen) relights glowing splint *	Test 2 Add sodium hydroxide, then		Off-white ppt*	No change	leave to stand		brown ppt on standing*		Test 3 Add aqueous iron(II) sulfate	Turns colourless / yellow OR colourless / yellow solution formed*	No change	
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3(c)(ii)	manganese / Mn																									

3(c)(iii)		FA 6 / FA 7	FA 8
	oxidation state	(+)7	(+)2

3(a)(i)	- selects (aqueous) silver nitrate and (aqueous) ammonia * - white ppt * - soluble in (aqueous) ammonia * - NaCl * 2 * = 1 mark
3(a)(ii)	(The acid) removes / reacts with the hydrogencarbonate ions OR silver ions react with hydrogencarbonate ions
3(b)(i)	- green (at start) * - turns to a black powder / solid * - powder very fluid / moves around the test-tube * - condensation (on walls of test-tube) * 2 * = 1 mark
3(b)(ii)	- forms green-blue solution * - effervescence * - vigorous reaction * - attempts to test with limewater * - gas / carbon dioxide gives white precipitate / solid with limewater * 2 * = 1 mark

3(b)(iii)	Test 1 Add NaOH(aq)	(pale) blue precipitate insoluble in excess *
	Test 2 Add NH ₃ (aq)	(pale) blue precipitate * (precipitate dissolves forming) dark / deep blue solution in excess *
	Test 3 Add aluminium foil	effervescence / fizzing* (gas) pops with a lighted splint * pink-brown solid * turns colourless / pale blue solution formed * gets hotter *
	Metal ion in FB 7 : Cu ²⁺ *	
	2 * = 1 mark	
3(c)(i)	Test 1 Add NaOH(aq)	green precipitate * insoluble in excess * (precipitate) turns brown (on surface) *
	Test 2 Add acidified KMnO ₄	purple to colourless / (pale) yellow solution OR KMnO ₄ decolourised*
	2 * = 1 mark	
	Metal ion in FB 8 : Fe ²⁺	
3(c)(ii)	Redox reaction AND change to colourless linked to reduction of manganate(VII) ions OR change to yellow colour linked to oxidation of Fe ²⁺ or production of Fe ³⁺ .	

3(a)		<i>observations</i>		
	<i>test</i>	FB 6	FB 7	FB 8
	Test 1 MnO ₂	No change	No change	Fizzing * Heat released * (Gas / oxygen) relights a glowing splint *
	Test 2 Mg	Fizzing * Heat released (only award if not awarded for FB 8 test 1) (Gas / hydrogen ignites with) a pop (sound) with a lit splint *	No change / no fizzing	No change
	Test 3 FeSO ₄	No change * (award one * if both no changes highlighted correctly recorded)	Green ppt * (ppt) turns brown (on standing) *	Either solution OR turns AND yellow / yellow-orange / orange-brown / yellow-brown / (light) brown * Fizzing * (Gas / oxygen) relights a glowing splint (only award if not awarded in FB 8 test 1 above)
2 * = 1 mark (round down)				

3(a)(ii)	FB 6 CH_3COOH / formula of any acid containing O FB 7 NaOH / formula of any Group 1 hydroxide FB 8 H_2O_2
3(b)(i)	Fizzing* Forms colourless solution* Attempts limewater test* Gas gives white ppt with limewater *
3(b)(ii)	Cream / off-white ppt AND Partially soluble / insoluble in (aqueous) ammonia
3(b)(iii)	M1 Test 1 No change / no ppt AND (on heating) gas / fizzing / ammonia turns litmus blue
	M2 Test 2 Brown or yellow solution OR turns brown or yellow
3(b)(iv)	cations: NH_4^+ and unknown anions: Br^- and CO_3^{2-}
3(b)(v)	$\text{Ag}^+(\text{aq}) + \text{Br}^-(\text{aq}) \rightarrow \text{AgBr}(\text{s})$